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DISSERTATION
CONCERNING
ELECTRICITY.

(Price One Shilling.)

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A

DISSERTATION

CONCERNING

ELECTRICITY.

By *J. T. DESAGULIERS*, LL.D. F.R.S.

Chaplain to HIS ROYAL HIGHNESS
the PRINCE of *WALES*.

To which is Annex'd,

A Letter from President *BARBOT*
perpetual Secretary of the Academy of
Bordeaux, to acquaint him that his Differ-
tation had won the Prize proposed by that
Academy to be given to the Person who
should write best upon that Subject.

L O N D O N :

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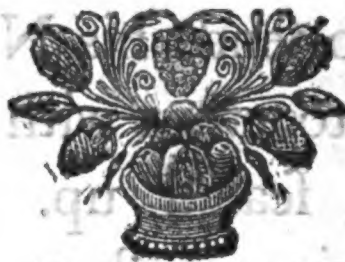




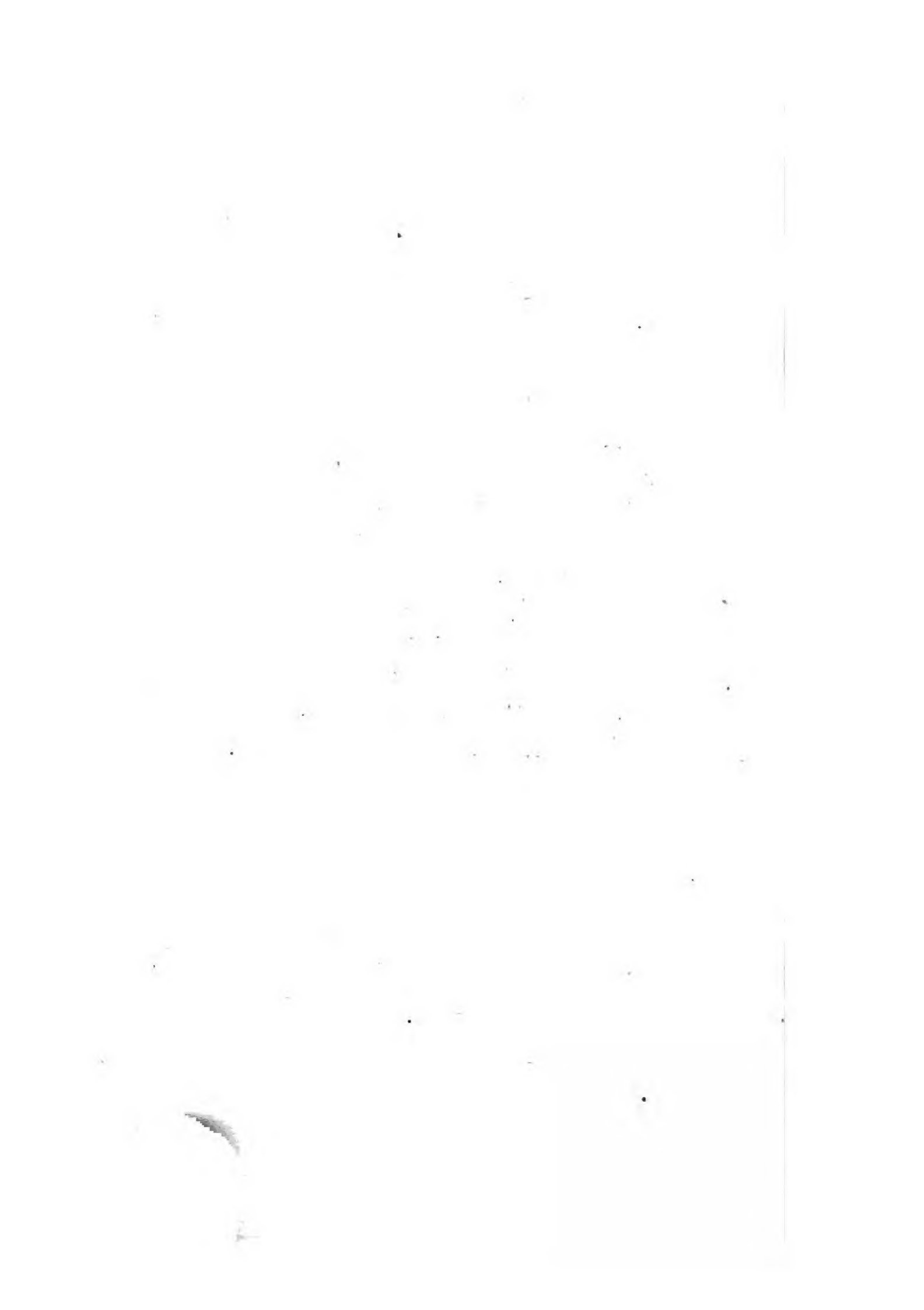
N. B. **E**VERY Author of a Dissertation on the Subject proposed, writes some Motto or Sentence at the bottom of his Dissertation ; and also sends his Name and Titles, together with the same Motto, sealed up. The Academicians first examine all the Dissertations without knowing their Authors, and when they have adjudged the Prize to any one of the Dissertations,

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tions, they open the sealed Papers to find out the Author, whose Name has along with it the Motto of the Paper winning the Prize.



N. B. *For the sake of such Persons as are curious to know what Electrical Experiments have been made ; those Places in the Philosophical Transactions of London, and in the Memoires of the Royal Academy of Sciences of Paris, and other Treatises concerning this Subject, are referred to, where the Experiments are described at large.*





A

DISSERTATION

CONCERNING

ELECTRICITY.

ELECTRICITY is a Property of some Bodies, whereby they alternately attract and repel small Bodies when brought near them, and that at sensible Distances, *viz.* from a quarter of an Inch to the Distance of two or three Foot, and sometimes beyond.

The first kind of Bodies in which this Virtue or Property has been observed is the *Electrum* or Amber, for which Reason it has been called *Electricity*, which Name has been retained, tho' the same Virtue has been observed in a great number of other Bodies ; as for example, in all sorts of Glafs, Crystals, and precious Stones ; Refins, Sulphurs, and

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some Minerals ; dry animal Substances, and Vegetables (tho' rarely) but never Water and watery Fluids, moist Bodies, and Metals.

The Electricity which is inherent in several Bodies is hardly perceptible, unless they have a vibratory Motion given to them, by Friction or any other Means, so as to cause them to throw out *Effluvia* or Emanations.

I distinguish all Bodies into such as are *Electricks per se* (or of themselves) and *Non-Electricks per se*. A Body that is *electric per se*, is such an one in which Electricity may be excited by some Action upon that Body, such as rubbing, patting or warming it, and sometimes only exposing it to cold and dry Air after it has been covered, &c. A *Non-Electric per se* is a Body which cannot be excited to Electricity by any Action upon the Body itself. But yet *Non-Electricks per se* receive Electricity, when you bring near them *Electricks per se* in which Electricity has been excited. In order to know, that Non-Electricks have received the communicated Electricity, they must be *insulated*, that is, they must not be suspended from, or supported by any Bodies but what are *Electricks per se*; for if a Non-Electric be touched
by

by another Non-Electrick, which touches a third, and so on ; all the Electricity received by the first will go to the second, and from the second to the third, and so on, till at last it be lost upon the Ground, or the Earth. But if several Non-Electricks touching one another, are at last terminated by Electrick Bodies, in that respect they make but one Body, and receive and retain Electricity for some time.

There are several ways of finding when Non - Electricks have received Electricity ; (which is generally communicated to them by applying a Glass-Tube, excited by Friction, to one End of those Bodies) of which here follow a few. If an Iron-Bar be suspended horizontally by two silken Strings that are very dry, and the rubb'd Tube be applied or brought near to one of the Ends of the Bar, and then some Leaf-Gold or Leaf-Brass, or any other light Bodies plac'd upon a small Stand be brought near the other End, they will be alternately attracted and repell'd by the Bar. Likewise if you bring your Face or the End of your Finger near the said End of the Bar ; the electrical Effluvia coming out on the sudden will make a sensible Prick-

ing, with a snapping Noise, and produce a Flash of Light that may be seen in the dark. A small flaxen Thread about a Foot or two long, suspended by a Stick, and being brought near the Bar, will be attracted by it without destroying its Electricity till after some time. That Thread (which we shall call *the Thread of Tryal*) serves to find out when the Bar or any other non-electrick Body has receiv'd the communicated Electricity.

A Body which is *electrick per se*, does not receive this Virtue from another *electrick per se* tho' excited, till it is become a *non-electrick*; which happens when it is made moist; and then it will be made electrick only by Communication. So that an *electrick per se* may become *non-electrick*; and likewise a Body *non-electrick per se* may become electrick by Communication.

Those electrick Bodies in which it is difficult to excite Electricity, may be look'd upon as *Non-Electricks*, when their Electricity is not excited: and then they will be in the same Condition as *Non-Electricks per se*, and be liable to receive Electricity by Communication in the same manner.

As there are a very great number of electric Bodies, which act after the same manner when Electricity has been excited in them, I shall here mention only the Tube of Glass which is rubb'd by the Hand, referring my Reader for the Enumeration of other electric Bodies, and their Effects, to the late Mr. *Hare's* Book of Physico-mechanical Experiments, to the Philosophical Transactions of *London*, to the Memoirs of the Royal Academy of Sciences at *Paris*, and to the other Authors who have written upon this Subject.

The Glass-Tube commonly us'd in electrical Experiments is about three Foot and an half long, an Inch and an half in diameter, and about $\frac{1}{4}$ of an Inch thick, open at both Ends, but sometimes hermetically seal'd at one End, viz. that which is furthest from the Hand. These Proportions are not strictly necessary: only this Bigness is most convenient for the Hand; and when the Thickness is less than $\frac{1}{4}$ of an Inch, the Electricity is sooner excited by Friction, but it does not last so long as when the Tube is thicker. You must hold the open End of the Tube (when it has one End shut) in the left Hand; and it
must

must be rubb'd up and down several times with the right Hand, holding dry Paper or dry Cloth in your Hand: but the Hand alone is much better, provided it be very dry, which seldom happens. It is also very proper to warm the Tube a little by the Fire to dry it before you begin to rub it; but absolutely necessary to do it when the Air is moist, which is the most inconvenient Weather for making these Experiments. Dry and cold Air is the most proper, for then very little Friction is sufficient; but you must rub the Tube a great while, and the Electricity continues but a little while when the Weather is moist.

To know whether the Tube has been rubb'd long enough, and the Electricity sufficiently excited, you must strike your Fingers cross-wise near the Tube, but without touching it, at the Distance of about half an Inch, and you will hear a snapping from the electrical Effluvia, which going from the Tube strike against the Fingers and rebound again to the Tube. Then you may be sure that the Tube is in a Condition to produce its Effects, being fully prepar'd for making electrical Experiments; but you must not forget

serve to explain the Principles that I lay down ; by which one may always certainly foretell what will happen to any Body which is excited to Electricity, or any other Body which receives the Electricity communicated from a Body in which Electricity has been excited.

EXPERIMENT I.

Having laid small Pieces of Leaf-Gold or Leaf-Brass, or any other small Bodies upon a little Stand whose Surface or Top was seven or eight Inches Diameter, the rubb'd Tube having been brought within a Foot or two of the Stand, the small Bodies were alternately attracted and repell'd for some time ; and sometimes they were repell'd from the Tube as they were coming towards it, even before they had touch'd it, and also came back from the Stand towards the Tube without having touch'd the Stand, jumping backwards and forwards with great Swiftneſs.

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EXPERIMENT II.

Having tied a Down Feather to the top of a wooden Broach or Skewer of about six or seven Inches in Height, and fix'd upright upon a Foot; when you bring the excited Tube near it, all the Fibres of the Feather stretch out towards the Tube; but as soon as you remove the Tube, the Fibres of the Feather turn back and stick strongly to the Skewer. If you bring your Finger near to the Feather while its Fibres are tending towards the Tube, being attracted by it, the Finger will repel them; but as soon as you remove the Tube, they are attracted by the Finger. If you cover the Feather with a Glass Recipient (such as are us'd on the Air-Pump) that is very dry, the Tube will attract the Feather in the same manner thro' the Glass: and this happens even when the Recipient has been exhausted of its Air by the Pump. When the Tube is rubb'd near the Recipient, whether it be full of Air or empty, the Fibres of the Feather follow the Motion of the Hand along the Tube, rising and falling upon the Broach or Skewer.

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EXPERIMENT III.

Without making use of the Tube, if you rub the Recipient that covers the Feather, with both Hands, the Fibres of the Feather will stretch themselves out towards the Glass like the Rays of a Sphere. If you rub but with one Hand, the Fibres will stretch themselves towards that Part of the Glass which is rubb'd: and then when you blow against the Glass, those Fibres will be repell'd notwithstanding the Interposition of the Glass; which happens also when you strike the Air with the Hand towards the Feather without touching the Recipient.

EXPERIMENT IV.

After the Tube has been rubb'd, if any Assistant lets go a Down Feather in the Air at the Distance of a Foot or two from the Tube, the Feather will jump towards the Tube with an accelerated Motion, and adhere to it for some time; and then of a sudden it will be repell'd from the Tube, and will fly about in the Air in such manner, that the
nearer

(II)

nearer you bring the Tube to it, the more it will be repell'd, till it has touch'd some other Body; and then it will be drawn again by the Tube; which after some time will drive it away again. Sometimes when the Finger is held at eight or ten Inches from the Tube, the Feather will jump from the Tube to the Finger and from the Finger to the Tube thirty or forty times together.

EXPERIMENT V.

If a String of any kind be stretch'd horizontally, and from that String you hang a Thread of Silk about three Foot long and very dry, and to the lower End of that Thread you fasten a Down Feather; then at the Distance of about two or three Feet hang up another Feather, but by a flaxen Thread; the rubb'd Tube being brought near will attract the first Feather, which, when it has adher'd to it a little while, will fly from the Tube, and then be repell'd by it every time the Tube is brought near, till it has touch'd some other Body, as in the Fourth Experiment; and then it will be attracted anew. But the Feather which is suspended by the flaxen Thread will

always be attracted at the Approach of the Tube, and never repell'd. N. B. *If you wet the filken Thread, the Feather hanging at it will be repell'd no more, but always attracted by the Tube.*

EXPERIMENT VI.

When the excited Tube is brought near your Face, you will feel the electrick *Effluvia* like small Hairs which will strike your Eyes and Cheeks, draw the Hairs of your Eye-brows, and make a small crackling Noise.

EXPERIMENT VII.

If you make use of a Tube which is hermetically seal'd at one End, and has at the other End a Brass Ferril with a Screw, by which means you may pump out the Air from it : If you rub the Tube after you have exhausted the Air, it does not attract any more, nor give any Light outwardly ; but it gives much more Light within. Then if, by opening the Cock a little way which is fastened to the Tube, you let in the Air slowly
whilst

whilst you rub the Tube, the Light diminishes, and being interrupted by the Air as it comes in, looks like Lightning at a Distance, till all the Air is come in, and then there is no more Light within ; but the Light goes all to the Outside, and the Attraction returns.

EXPERIMENT VIII.

If upon the Stand mention'd in the First Experiment you set up edgewise two little Boards about nine Inches long, six Inches wide, and three quarters of an Inch thick (two small Octavo Books will do as well) parallel to each other, and about the Distance of ten Inches asunder ; little Pieces of Leaf-Gold or Brass laid upon the Stand between those Boards, will not be attracted by the rubb'd Tube held near them, till it be brought quite between the said Boards, as near to the Stand as half the Distance of the Boards from each other : that is, when the Tube is so held that a Circle describ'd round the Axis of the Tube with the Distance that is between that Axis and the Stand, passes between the Boards or Books without touching them.

them. But when the rubb'd Tube being held horizontally at the Distance of a Foot from the Stand, seems to have no Virtue, because the Leaf-Gold has no Motion; if an Assistant snatches away the Boards all on a sudden, the Pieces of Gold will be attracted and repell'd several times, without giving any new Friction to the Tube.

EXPERIMENT IX.

When the Air is very dry, and the rubb'd Tube can attract the Leaf-Gold laid on a small Stand, to the Distance of three Foot or beyond; if the same Leaf-Gold be laid upon a Table or any large Surface, you must bring the excited Tube very near before it can produce its Effect.

EXPERIMENT X.

When the Air is moist, the fourth Experiment does not succeed well; for after the Feather in the Air has been some time driven about by the Tube, it comes back of itself to the Tube without having touch'd any other Body; and sometimes after having adhered
to

to the Tube towards the middle of it, it flies off of it and comes again immediately to the Tube, sticking to that Part of it which is farthest from the Hand. It happens also, when it is very dry and the Tube repels the Feather, (after having attracted it) to the Distance of two or three Foot ; that if you wet the Top of the Tube at the End for the Length of six or seven Inches, the Feather will come and stick to that End of the Tube without having touch'd any other Body.

EXPERIMENT XI.

Having fill'd with Water a small Drinking-Glass of about an Inch Diameter, when you bring the rubb'd Tube near it, the Water rises in a little Hill accumulated at the Edge of the Glass, sometimes jumping towards the Tube in a little Jet, so small that you can hardly see it, tho' you may find the Tube wholly wet with it. One may also observe that this accumulated Water rises in the Shape of a small Cone whose Axis is sometimes stretch'd out horizontally towards the Tube, then snaps and falls down again flat upon the rest of the Water. If this Experiment be
made

made in the dark, a Flash of Light accompanies the snapping.

EXPERIMENT XII.

If by means of an artificial Fountain (in which Air is condens'd upon the Water to make it spout) you play a small Jet of about the 40th part of an Inch Diameter, upwards or downwards: the rubb'd Tube being brought near, the Jet will bend towards the Tube at the Distance of a Foot; and if the Tube be brought nearer, the Jet being wholly drawn away by the Tube, is chang'd into a Dew upon the Tube, so that it adheres to the Tube in little Drops, provided the Jet be not made to spout with too much Force.

Here follow some remarkable Effects of Electricity communicated to Bodies which are Non-electricks per se.

EXPERIMENT XIII.

Having stretch'd horizontally a Packthread or hempen String to the Length of about twelve hundred Foot, at the End of which
was

was suspended an Ivory Ball of about an Inch and an half in Diameter ; this Ball has drawn and repell'd Leaf-Brafs or Leaf-Gold when the rubb'd Tube has been brought near the other End of the String: the Thread of Tryal being also brought near to the said Ball was attracted by it.

N. B. *All the Supporters of this String must be Electricks per se, whether they be Hair-Ropes, Fiddle-strings, or Cat-guts, Ribbons, Strings of Silk, Glass Tubes, long Bodies of Sulphur or of Resin, &c. and all those Bodies very dry. We shall hereafter call the non-electrick Body, which being stretch'd out in length, receives the communicated Electricity, the Conductor of Electricity; and the Bodies on which it rests, or from which it is suspended, the Supporters of the Conductor of Electricity.*

EXPERIMENT XIV.

If you wet the Conductor of Electricity, the Experiment will succeed the better ; but you must take care not to wet the Supporters: for if the least of the Supporters, for

D example

example the first, be wet, it becomes a *Non-electrick*, and thereby conducts the Electricity that comes to it to the Body which it touches, and from thence to the Ground, where it is lost, not suffering it to go any farther upon the Conductor. If you examine the Supporters by bringing the Thread of Tryal near them, you will find them to be electrick about five or six Inches on each side of the Conductor, more or less as the Air is more or less moist; the Supporters being as it were saturated with the communicated Electricity in a little space near the Conductor.

EXPERIMENT XV.

If instead of stretching the Conductor at length, you carry it backwards and forwards upon the Supporters several times in parallel Lines, provided those Lines be distant enough from each other (for example about three Foot distant) the communicated Electricity will run as far backwards and forwards as if the String had gone streight on, and will give as much Virtue to the Ball at the End of the Conductor.

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EXPERIMENT XVI.

If the Conductor is stretch'd out in the form of a Star, the electrical Virtue will be perceiv'd at all the Points of it. For example, if the Conductor be stretch'd from the first Supporter about forty Foot in length, and then divided into five Branches of twenty Foot long each, separated from each other in the manner of a Star, with a Ball at the End of each String or Point; when you bring the rubb'd Tube near the beginning of the Conductor, you will find by Threads of Tryal that all the Balls have receiv'd the Electricity at the same time.

EXPERIMENT XVII.

Having supported, or suspended by electric Bodies, an Iron-Bar nine Foot long, which had three Branches pointed at the End at the Distance of two Foot from each other, the Electricity communicated from the Tube at the other End, was felt at the same time by the Cheeks of three Persons which brought their Faces near the three Points, by a snap-

ping Noise, a Pricking, and a Flash of Light seen in the dark.

EXPERIMENT XVIII.

Having suspended a Man horizontally (as in a swimming Posture) by two Hair Ropes, that Man becomes a Conductor of Electricity. That which he receiv'd by the Approach of the rubb'd Tube brought near the Soles of his Feet, made him strongly attract the Thread of Tryal and Leaf-Brafs with his Head and his Hands; and likewise with his Feet, but very weakly. But when the Tube is brought near his Head, then his Feet attract very strongly. Then if the Man (when the rubb'd Tube is brought back to his Feet) holds out his Finger near the Face of any Person standing by, a Flash of Light will fly from the Finger, a snapping Noise will be heard, and both the Man on his Finger and the Assistant on his Cheek will feel a Pricking at the same time. In the same manner, if any one moves the Hand cross-wise near the Arms or Legs of the Person suspended, they will both feel the same Pricking; and if one puts an Iron-Bar near the Person suspended, he

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will

will hear the Snapping and feel the Pricking. What is remarkable is, that if the Man hanging horizontally has on a Cloth Coat that is quite dry, you will feel no pricking when you pass your Fingers near the Coat, and the Thread of Tryal will be but weakly attracted by it, nay sometimes not at all.

N. B. *Any other Animal suspended will produce the same Effect.*

EXPERIMENT XIX.

The Electricity receiv'd by the Conductor advances from one End of it to the other in a kind of Cyndrick *Vortex*, as may be seen by the following Experiment. Having carried a Packthread Conductor of Electricity thro' the middle of a wooden Hoop fix'd vertically upon an open Glas Cyndrick Recipient, its Plane being at Right-Angles with the Packthread: when you bring the rubb'd Tube near to one End of the Packthread, not only the Ball at its other End becomes electrick, but also the whole Circle or Hoop tho' six Foot distant from the Ball; for the said Hoop attracts the Thread of Tryal by all its Parts.

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EXPERIMENT XX.

Having suspended the before-describ'd artificial Fountain, by Fiddle-strings, and having open'd its Cock to make its Jet play, horizontally, or obliquely, or vertically upwards; if the rubb'd Tube be brought near the Body of the Fountain, the Electricity will be communicated to the whole Jet, which will then in every part of it attract the Thread of Tryal; the Jet becoming then a Conductor of Electricity.

EXPERIMENT XXI.

If you suspend two or three Iron-Bars in the same horizontal Line, at the Distance of six Inches from one another, the Electricity communicated by the rubb'd Tube to the End of one of the Bars will go on from the one to the other quite to the End of the last Bar, where a Pricking will be felt, a Noise heard, and a Flash of Fire seen. If the Air is dry, the Electricity will jump from one Bar to another at a greater Distance; but in moist Weather

Weather the Bars must not hang above an Inch distant from each other.

EXPERIMENT XXII.

Having* by a Fiddle-string suspended a Bough of a Tree which had about four or five hundred Leaves, upon the Approach of the rubb'd Tube all the Leaves attracted the Thread of Tryal. Then having stretch'd a Rope from that Bough to another suspended in the same manner at the Distance of thirty Foot from the first: the Tube brought to one of the Boughs gave Electricity equally to the two. Afterwards substituting a very small flaxen Thread, instead of the Rope, from one Bough to the other; the Electricity was communicated as easily as before.

EXPERIMENT XXIII.

When a small String of white Silk of about the same Size as the flaxen Thread, was stretch'd from one Bough to the other, the Electricity communicated to one Bough did not go to the other: but having wet the
Silk,

Silk, it conducted the Electricity to the other Bough as well as the flaxen Thread.

EXPERIMENT XXIV.

Having mix'd Bees-Wax with about eight times its Quantity of Refin to hinder it from being brittle, and having melted and cast the whole in a round Mould of about ten Inches Diameter and three Inches deep, spreading from the Bottom upwards, a Cake was made, which when cold appear'd to be a Body electrick *per se*. This Cake being warm'd, rubb'd, or patted with the Hand, attracts the Thread of Tryal; and sometimes does the same without any thing being done to it, but exposing it to the Air. If you set this Cake on the Ground, and a Man stands upon it, stretching out his Arms horizontally, when the rubb'd Tube is applied to one of his Hands the whole Body of the Man will be impregnated with Electricity; but that Virtue will be most sensible at that Part which is most distant from the Tube, which is the Man's opposite Hand; to which if an Assistant bring his Face near, he will feel the Pricking, see the Flash of Fire, and hear the Snapping;

Snapping ; the Man, render'd electrical, feeling, seeing, and hearing the same. If another Man standing upon another Cake of Resin (or a Cake made of Sulphur, or any other Substance that is electrick *per se*) at a distance, as for example at thirty Foot from the first Man, holds in his Hand the End of a Packthread or any other non-electrical String, of which the first Man holds the other End ; the Electricity communicated to the first Man by the Application of the rubb'd Tube, will be communicated to the second, who makes it be felt by those that come near his Hand that is most distant from the Tube. But if the least flaxen Thread falls from the Packthread, or from the Clothes of either of the Men, so as to touch the Ground, the Electricity will not go beyond that Thread ; but running down in that Place along the Thread, is lost upon the Ground or the Earth. If fifty Men stood upon as many electrical Cakes, communicating one with another by their Hands, or by any Non-electricks, the last will be strongly impregnated with the Electricity that the rubb'd Tube gives to the first.

N. B. This has been tried with a dozen Men ; and it is not known how far this communicated Electricity may be carried.

Electricks *per se*, whilst they are in a State of Electricity, can receive no communicated Electricity (or receive but very little of it at their Ends) from the Tube or other Electricks *per se* excited ; and cannot then become Conductors of Electricity : but it is easy to change them into Non-electricks, and then they will become Conductors of Electricity like others.

The following EXPERIMENTS shew how Electricks per se become Non-electricks.

HA V I N G suspended horizontally by dry Silks a Glass-Tube six or eight Foot long, also very dry, at the End of which is fasten'd an Ivory-Ball, you cannot give that Ball any Electricity by applying the rubb'd Tube to the other End of the suspended Tube : but as soon as you wet the suspended
Tube

Tube from one end to the other with a Sponge, that Tube conducts the Electricity, and the Ivory-Ball attracts.

EXPERIMENT XXVI.

As it has been shewn that communicated Electricity, as it is conducted, jumps from one non-electrick Body to another; it is not necessary that the Moisture of the suspended Tube should be continuous; for after the Tube has been well dried, if you suspend it anew, and find that it cannot receive or conduct any more Electricity, you need but to blow thro' it with your Mouth, and the Moisture of your Breath will render it non-electrick, whereby it will again receive and conduct Electricity, the Ivory-Ball acting upon small Bodies as before. Sometimes the changing of Bodies from electrick into non-electrick happens only by the changing of the Condition of the Air, when from being dry it becomes moist.

EXPERIMENT XXVII.

Having stretch'd a Packthread Conductor of Electricity to a Length of twenty Foot, upon three electrical Supporters, of which the middle one was a Stick of Sealing-wax, the Electricity receiv'd from the rubb'd Tube applied to one end of the Conductor appear'd at the Ball suspended at the other end : but when instead of the Ball the Stick of Wax that had been us'd as a Supporter was suspended at the end of the String, the Thread of Tryal has not been attracted by this suspended Wax, except at its upper end joining to the Packthread ; but upon wetting the Wax, it attracted the Thread of Tryal strongly in all its Length. Then replacing the Ball, and restoring the wet Wax to its Place where it was before a Supporter of the Conductor of Electricity, the communicated Electricity was stopp'd at the Wax, and wou'd go no farther till the Wax was dried.

There are Bodies which one wou'd take for Non-electricks *per se*, because every time they are suspended by electrick Bodies, they receive

receive (and become Conductors of) the Electricity communicated by the excited Tube: but if you dry them well at the Fire; and rub them very much, they may be made electrick. These Bodies, and those which from being strongly electrick are become non-electrick by Moisture, will indeed receive Electricity from the rubb'd Tube, and conduct it to their Ends, but in less Quantity, and do not accumulate it so strongly as the Non-electricks *per se*. This is the Reason that we see less Light at the End of a wooden Bar than at the End of an Iron one; and that we hardly feel any pricking at the End of the first, tho' both have receiv'd their Electricity from the same Tube.

It has been thought that Animal Substances were electrick, and Vegetable Substances were not; because those that made the Experiments have generally succeeded in making use of Animal Substances for Supporters, and Vegetable Substances for Conductors of Electricity: but what is true in that Supposition, is only, that because Silks, Fiddle-strings, Strings of Woollen, or Hair, are very dry Substances; and Vegetables are usually

usually moist. For if you wet those Animal Substances, they all become non-electrick, and can no more serve as Supports for the Conductors of Electricity, but will receive it when communicated, and conduct it. Likewise when the Packthread which is usually made use of to conduct Electricity very far, has been rubb'd over with Glue and is very dry, it receives Electricity no longer, till you wet it to make it become non-electrick. A Man, or any other Animal upon a Cake of Resin, or suspended by Strings of Hair or Silk, is always non-electrick ; but is only so because he always has Moisture ; for when his Cloaths are dry, they are electrick *per se*, and therefore do not snap. *See the 18th Experiment.*

When we consider the different Circumstances of several Electrical Experiments, there seems to be a sort of Capriciousness, or something unaccountable in those Phænomena not to be reduc'd to any Rule. For sometimes an Experiment which has been made several times successively, all at once will fail ; or have a quite contrary Success, tho' the Circumstances seem to be the same. But I hope that the Conclusions which I have drawn
from

from the Consideration of several principal Experiments, are so general, that they will serve as Rules to explain all the Oddness which seems to accompany the electrical Experiments, and to foretell certainly all that must happen in the Approaches and Combinations of Bodies in respect of Electricity excited, or receiv'd by Communication. Before we give Examples of the Explication of the most remarkable Phænomena, we must make mention of some Experiments, from which among others are deduc'd two other general Propositions to be added to what I have said of Electricks *per se*, and of Non-electricks *per se*; and of the manner that the one and the other acquire or lose Electricity.

EXPERIMENT XXVIII.

Having suspended horizontally by two silken Threads, about four Foot long each, a small Glass-Tube very dry and a little rubb'd; if you apply to it long-wise the great rubb'd Tube, it will repel the little Tube till its Silks become inclin'd to the Horizon from being perpendicular before. Then having wet the little Tube, when you bring the
great

great rubb'd Tube near it, it is attracted by the great Tube till its Silks are remov'd from the Perpendicular inclining near to the great Tube. From this Experiment, and many others of the same kind, may be concluded that Bodies which are electrick *per se* being excited to Electricity repel all other Bodies that have Electricity; but attract them as soon as they have lost their Electricity, and so *vice versa*.

EXPERIMENT XXIX.

Having suspended a Down Feather by a silken Thread, as in the fifth Experiment, Sealing-wax well rubb'd produces the same Effect as the Tube, but more weakly, drawing the Feather; and when once it is separated from the Wax, the Wax repels it continually till the Feather has touch'd some other Body. But what is different here, is, that when the Feather is in a State of Repulsion in respect of the Wax, the rubb'd Tube attracts it; and when the Tube has given the Feather its repulsive State, then the rubb'd Wax attracts it: which shews that the Electricity of Glass is different from the Electricity

city of Wax. The late *Mons. du Faye*, Intendant of the *King of France's* Gardens at *Paris*, was the first that observ'd that there are two sorts of Electricity; and in a *Memoire* where he spoke of it, he shew'd the Way of finding what kind of Electricity belongs to any electrick Body whatever.

To shew the Usefulness of these Rules, Laws, or Principles of Electricity; we will make use of them to explain the odd Circumstances of some Experiments: as for example,

1^o. Why don't we feel a pricking on the Eyes when the rubb'd Tube is brought near to the Face; since the Ends of the Finger of a Man made electrick, or of an Iron-Bar made electrick, makes the Face that is brought near it feel a very sensible pricking?

Answer. Because the electrical Effluvia coming from the Tube to the Face, are only those which come from that Part of the Tube which is brought near the Face; whereas the Bar gives accumulated Effluvia of the Electricity which it has receiv'd from

F all

all its Length, and from the Tube at several Applications.

2°. What is the Reason that the Feather which, having been attracted by the Tube, is separated from it, and then always repell'd till it has touch'd another Body?

Answer. Because Electricks repel one another. For which Reason the Feather, as soon as it has been impregnated with the Electricity of the Tube, is driven from it; which continues as long as the Feather keeps its Electricity, which it loses as soon as it has touch'd another Body; then being again become non-electrick, the Tube attracts it anew; thus alternately receiving and losing Electricity, it jumps several Times from the Tube to the Finger and back again. See Experiment IV.

3°. What is the Reason this does not happen when the Air is moist?

Answer. Because the Feather being become electrical, draws the moist Particles that swim in the Air, and thereby losing its Electricity,

is again attracted by the Tube. The Tube also at the Place which has been the least rubb'd loses its Electricity by the moist Particles which it draws out of the Air, and becoming non-electrick in that Place (as it happens when it is made wet on purpose) draws the Feather before it has lost its Electricity.

4°. Whence comes it that a Conductor of Electricity does sometimes, without changing any thing, lose its Virtue, and cease to conduct Electricity, tho' you continue to rub the Tube at one of its Ends?

Answer. Because some one of the Supports of the Conductor has imbib'd the Moisture of the Air, by which it is become non-electrick. This has happen'd to me in making use of a long Piece of Hat by way of Support, one Day that the Weather was moist. This List of Hat, having been warm'd, supported the Conductor well and effectually; but in half an Hour having imbib'd some Moisture from the Air, it stopp'd the Course of the Electricity. When we make use of Glas-Tubes for our Supporters, this happens sometimes if the Air be very moist.

F 2 5°. Whence

5°. Whence does it happen that the Feather on the Skewer or Broach of Experiment 2, stretches out its Fibres, separating them from each other by the Attraction of the Tube, and that the Finger repels them when the Tube is brought near to the Feather, but attracts them when the Tube is remov'd ?

Answer. The Fibres of the Feather extend like the Rays of a Sphere, because being become electric they repel one another. The Finger repels them because it receives Electricity from the Tube; but when the Tube is remov'd, the Finger loses its Electricity, and then it draws the Feather which is still electrical.

6°. Whence does it happen that in the Eighth and Ninth Experiments the rubb'd Tube attracts the Pieces of Leaf-Gold or Brass much farther, when they are laid upon an *insulated* Stand, than when they are laid upon a Table, or when they are shut up on two sides upon the Stand by Books or Boards set edge-wise,

Answer.

Answer. Because the electrical Effluvia flying off from the Tube return again in a Circle towards it, and carry with them all the little non-electrick Bodies which they meet in their way at their Return; but if those non-electrick Bodies are too heavy to be brought towards the Tube, the electrical Effluvia adhering to them, and sliding along those Bodies, lose themselves when the Bodies are not *insulated* or terminated by Electricks: but when they are, the Electricity or electrick Effluvia accumulate at the Ends of those Bodies which are the farthest from the Tube. N. B. *The Tube attracts the Feather when it is cover'd with a Glass Recipient, because the electrical Emanations like Light (of which they seem to participate) easily penetrate electrick Bodies which do not hinder their Circulation.*

For want of having establish'd Rules (that is Principles deduc'd from Experiments) by which one may explain the most odd *Phænomena*, People have imagin'd several Properties to belong to the Electricity of some Bodies, which at last Experience has disprov'd. As for example, That Bodies of different Colours
receiv'd

receiv'd more or less Electricity ; which happen'd only because when the Experiment was first try'd, some happen'd to be more or less moist than others. It has also been thought by some, that small electrick Bodies suspended by a fine Thread circulated round a Ball of Iron laid upon a Cake of Refin, after the manner of the Planets round the Sun ; which only happen'd because the Man that made the experiment had a great mind that the Thing should be so, and communicated that Motion to the little Body suspended without knowing that he did it; for this did not happen to any other Person that held the Thread and pendulous Body without the same Inclination. The same may be said of several other Circumstances which are not worth mentioning.

Though I have not endeavour'd to guess at the Cause of Electricity, or its Use in the physical World ; not having *Phænomena* to establish them sufficiently, I hope to have satisfy'd the Gentlemen of the Academy as to what they can expect upon this Subject, in giving Rules or Principles to explain or account for the electrical Experiments that have been
made

made hitherto, and perhaps such as may be made hereafter.

Yet if Conjectures are desir'd, here follow some :

I suppose Particles of pure Air to be electrick Bodies always in a State of Electricity, and that *vitreous* Electricity.

1st, Because Particles of Air repel one another without touching, as has been deduc'd from Experiments and Observations,

2^{dly}, Because when the Air is dry, the Glas Tube rubb'd (or only warm'd) throws out its *Effluvia*, which the Air drives back to the Tube ; from whence they dart out anew, and so move backwards and forwards with a vibratory Motion, which continues their Electricity.

3^{dly}, Because the Feather made electrick by the Tube, and darted from it, keeps its Electricity a long time in dry Air ; whereas when the Air is moist, the moist Particles which are non-electrick, floating in the Air, and
being

being attracted by the Feather, adhere to it, and soon make it lose its Electricity; which also happens even to the Tube in a little time.

From this Consideration it will be easy to account for a famous Experiment of the late Mr. *Hauksbee*, which is this: —

Having pump'd out all the Air from a Glass Globe, he caus'd it to turn on its Axis very swiftly by means of a Rope with a Wheel and Pulley; then rubbing the Glass with his Hand during its Motion, there appear'd a great deal of Light of a purple Colour within the Globe, without any Light or Attraction observ'd on the Outside of the Glass, which is observ'd when the Air has not been pump'd out. Then turning the Cock so as to readmit the Air gently into the Globe during its Motion, the Light was broken and interrupted, diminishing gradually, till at last it appear'd only on the Outside of the Glass, where it was accompanied with Attraction. Does it not appear to be, that at first the external Air, by its Electricity, drives back the electric Effluvia of the Glass, which go then to the
Inside

Inside of the Globe, where there is the least Resistance? For we observe that as the Air comes in, it repels the electrick Effluvia, that go inwards no longer when all the Air is come in. If the Fact be so, as the Experiment shews, is not my Conjecture prov'd, viz. that *the Air is Electrical?*

In the Reverend and Learned Dr. *Hales's Vegetable Staticks*, several of his Experiments shew, that Air is absorb'd, and loses its Elasticity by the Mixture of sulphureous Vapours, so that four Quarts of Air in a Glass Vessel will, by the Mixture of those Effluvia, be reduc'd to three. Will not this Phænomenon be explain'd by the different Electricity of Sulphur and Air. The Effluvia of Sulphur being electrick repel one another: and the Particles of Air being also electrick, do likewise repel each other. But the Air being electrical of a vitreous Electricity, and Sulphur of a resinous Electricity, the Particles of Air attract those of Sulphur, and the *Moleculæ* compounded of them becoming non-electrick lose their repulsive Force.

It has for a great while been thought that watery Vapours that rise in the Air to form
G Clouds.

Clouds, used to rise, because the Water which is of itself specifically heavier than Air (being form'd into little hollow Spherules or Bubbles fill'd with an *Aura*, or thinner Air than the ambient Air) in this new State made a Fluid of little Shells specifically lighter than the ambient Air in which it must rise like Smoke; but Philosophers are no longer of that Opinion; and such as have implicitly come into it, may find it refuted in the *Philosophical Transactions*, Numb. 407.

Now may not this Phænomenon of the Rise of Vapours depend upon Electricity in the following manner?

The Air which floats at top of the Surface of the Water is electrical, and so much the more as the Weather is hotter. Now in the same manner as small Particles of Water jump towards the electrick Tube, may not these Particles jump towards the Particles of Air which have much more specifick Gravity than very small Particles of Water, and adhere to them? Then the Air in motion having carried off the Particles of Water, and driving them away as soon as it has made them electri-

electrical, they repel one another, and also the Particles of Air. This is the Reason that a cubic Inch of Vapour is lighter than a cubic Inch of Air ; which would not happen if the Particles of Vapour were only carried off in the Interstices of Air, because then a cubic Inch of Air loaded with Vapour would be made specifically heavier than an Inch of dry Air ; which is contrary to Experiments, which shew us by the Barometer, that Air which is moist or full of Vapours, is always lighter than dry Air.

The END *of the* DISSERTATION.



C O N-



CONCERNING
The several AUTHORS
Who have treated of
ELECTRICITY.

THE Electricity of Amber, precious Stones, and some few other Bodies, was known long ago, and has been mentioned by several Authors, such as *Gassendus*, *Gilbert*, *Digby*, *Sir Thomas Brown*, and many others; but as what has been said by many Authors that have written long ago, has been repeated by others, I shall not mention several that have spoken superficially on the Subject, and written about it when but few electrical Phænomena were known.

The

The first worth mentioning particularly is Mr. *Boyle*, in whose Books you will find an account of several Phænomena of Electricity. See Dr. *Shaw's Abridgment*, Vol. I. from Page 397, to Page 510.

The next was Mr. *Francis Hauksbee* F.R.S. who made a great many new Experiments on the Electricity of *Glass, Amber, Sealing-Wax*, and several other Substances, and their Production of Light upon their Attrition in the Dark ; whether *in vacuo*, or in the open Air. See his Book of *Physico-Mechanical Experiments*, printed at *London* in the Year 1709 ; from Page 17, to Page 69.— From Page 109, to Page 127.— And from Page 131, to 139.

Afterwards Mr. *Stephen Gray* made several new and surprizing electrical Experiments, and pursued his Enquiries and Experiments for several Years till he died in the Year 1736 : An Account of which may be found in the *Philosophical Transactions*, N° 366. N° 417. N° 422. N° 431. N° 436. N° 439. N° 441. N° 444.

Monf.

Monf. *Du Faye* also made feveral new and curious Experiments upon this Subject, to be met with in the *History and Memoirs* of the *Royal Academy* of Sciences at *Paris*, for the Years 1733, 1734, and 1735; and in our *Philosophical Transactions* of *London*, in a Letter that he wrote to his Grace the Duke of *Richmond*, N^o 441.

Several Perfons in their Philosophical Works have quoted fome of thefe Experiments, but none fo fully as that ingenious and accurate Philofopher *Petrus van Mufchenbroek*, Profeffor of *Experimental Philofophy* and *Mathe-maticks* at *Leyden*; who has written a whole Chapter about it in his *Effays de Pbyfique &c. imprimés à Leyden chez Samuel Luchtmans* 1739. See the 17th Chapter of his firft Volume, from Page 254, to Page 272; where he gives a very particular account of moft of the electrical Experiments made within thefe twenty Years, till the Time that he writes; except fuch as had not been made, or had not been published before that Time.

The

The rest of the electrical Experiments made since Mr. *Stephen Gray's* Death were made by *Granvil Wheeler* Esq; mentioned in the *Philosophical Transactions* N° 253 ; and by myself N° 454. and N° 462 ; besides some others, which I lately shewed the Royal Society : An Account of which is not yet published, but will be in the *Transactions* this Winter. Indeed a few electrical Experiments, made by Mr. *Gray* and my self many Years ago, are mentioned in the First Volume of my *Course of Experimental Philosophy*, from Page 17, to Page 21.



(48)

A

L E T T E R

F R O M

PRESIDENT *BARBOT*, &c.

T O

DR. *DESAGULIERS*, &c.

A M O N S I E U R,

Monsieur le Docteur *Desaguliers*,
Chaplain de son Altesse Royale le Prince
de Galles, Membre de la Societé Royale
de Londres.

A L O N D R E S.

Bordeaux, 3 Aoust 1742.

M O N S I E U R,

JE vous apprends avec bien de la
joye que l'Academie de Bor-
deaux vient de donner le Prix à la
Differ-

Differtation que vous luy avès Envoyée sur l'Electricité, ce qui a pour devise, *Sero sapiunt Phryges*. Cét avantage est d'autant plus flateur que vous l'avès remporté sur un très grand Nombre de Rivaux.

COMME ce Prix consiste en une Medaille d'Or, je vous prie de charger quelqu'un a Bordeaux de la recevoir en votre Nom & d'en donner une quittance valable. Je suis ravy Monsieur d'être le premier a vous proclamer vainqueur, j'auray l'honneur des vous envoyer des Exemplaires de votre Differtation desqu'elle sera imprimée. Je ne doute pas que le Public ne la lise avec le même gout que nous l'avons Couronnée. Vous l'avès accoutumé depuis longtemps a recevoir tous vos Ouvrages

H avec

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avec applaudissement. J'ay l'honneur d'être avec une parfaite Estime & un Attachement respectueux,

MONSIEUR,

Votre tres-humble

& tres-obeïssant Serviteur.

B A R B O T.

MON adresse est à Mr. le President BARBOT, Secretaire perpetuel de l'Academie de Bordeaux, sur les fossés du Chapeau Rouge, à Bordeaux.

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